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LOBLOLLY PINE RELEASE STUDY

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LOBLOLLY PINE RELEASE

Report #25

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ABSTRACT

This study included two treatments: no release and aerial application of 2 pounds active ingredient of 2,4,5-T per acre during the second growing season. Hardwood competition was severe. At age 18, released plots averaged 169 percent more basal area and 215 percent more volume in standard cords than check plots. Cordwood yields were related to both a free-to-grow index estimated at age 2 ($r^2 = .868$) and hardwood basal area measured at age 18 ($r^2 = .784$).

INTRODUCTION

This is the twenty-fifth in a series of Occasional Reports concerning release of loblolly pine seedlings from hardwood competition. This study was installed on the privately-owned Price tract in Appomattox County, in the central Piedmont of Virginia. The previous stand was mixed pine and hardwood, primarily oak. Site preparation consisted of drum-chopping in September, followed by burning in November 1971. The area was planted in February 1972. The tract was released by aerial spraying in June 1973, during the second growing season, using 2 pounds active ingredient of 2,4,5-T per acre in a total volume of 5 gallons per acre. A small area on one side of the tract was left untreated as a check (Figure 1).

GROWTH PLOT INSTALLATION

Permanent 1/10-acre growth plots were installed in April 1974, at age 2. Six plots were installed, three each in the released and unreleased portions of the tract (Figure 1). Volunteer Virginia pine and shortleaf pine seedlings were pulled up when the plots were installed. Hardwood competition was severe, with sprouts of oak and red maple being the most serious competitors.

Measurements were made at age 2, when the plots were installed, and again at ages 6, 10, 14 and 18. At age 2, all loblolly pine seedlings were measured for height to the nearest foot, and classified as to free-to-grow status using a four-part classification system.¹ At later measurements, diameter at breast height of each loblolly pine was measured to the nearest inch, and a sample of trees in each diameter class was measured for total height to the nearest foot, noting which trees were dominant or codominant. For the final measurement at age 18, all hardwoods over .5 inch DBH were tallied by species, 1-inch diameter class, and crown class. Total height to the nearest foot was measured on about half of the intermediate hardwoods, and all of the codominant and dominant hardwoods.

¹ See Occasional Report No. 78 (Release Report No. 11) for a description and discussion of this classification system.

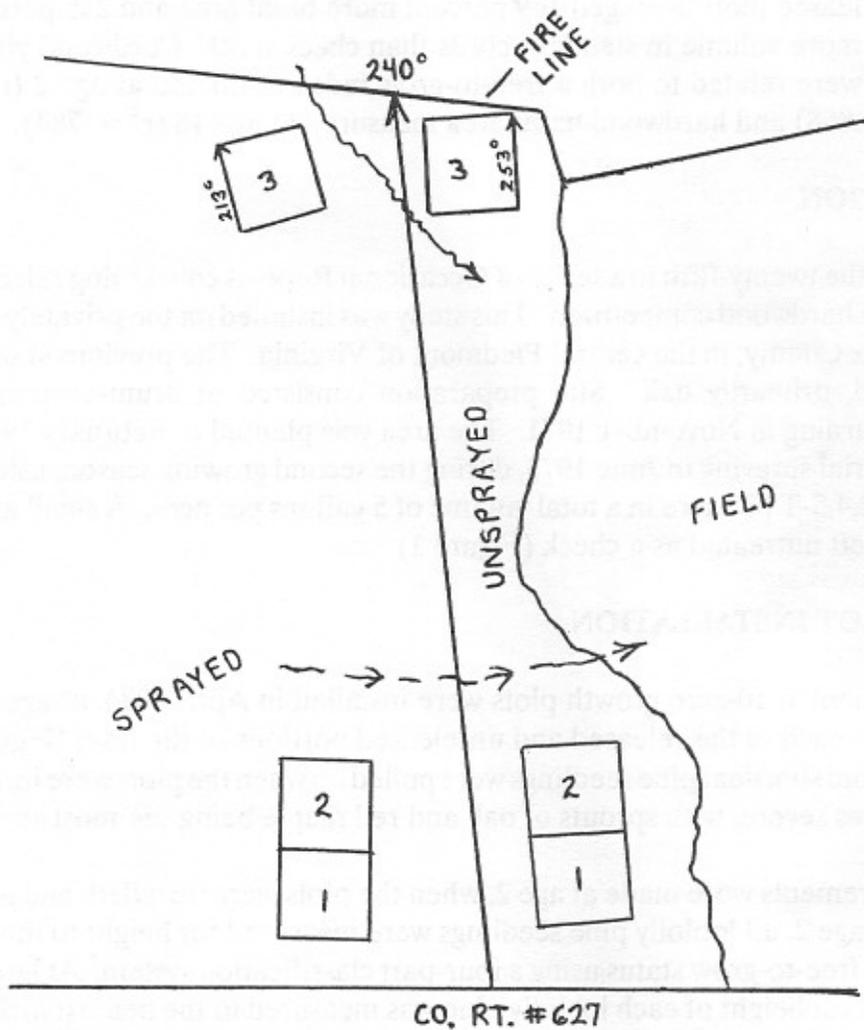


Figure 1. Layout of growth plots.

RESULTS AND DISCUSSION

A summary of loblolly pine data for the five measurements is presented in Table 1. At age 18, released plots averaged 12.7 standard cords per acre more than check plots.² Differences due to release increased with time (Table 2). Table 3 presents stand tables for loblolly pine at age 18.

A summary of average hardwood data at the final measurement at age 18 is presented in Tables 4 and 5, and individual plot data is presented in Table 6. Released plots had almost as many hardwoods as check plots, but only about half as much hardwood basal area. Released plots had considerably fewer hardwoods in the canopy at age 18, having only about 1/4 as many intermediate, codominant, and dominant hardwoods as the check plots.

There were a total of 35 codominant and 15 dominant hardwoods on the three check plots (167 per acre), and 7 codominant and no dominant hardwoods on the three released plots (23 per acre). About 3/4 of the codominant and dominant hardwoods were chestnut oak and red oak, and about half of the remainder were red maple. The average height of these dominant and codominant hardwoods was 39 feet on the check plots and 41 feet on the released plots. Some of these hardwoods will be able to maintain a position in the canopy. We estimate that check plot 1 will end up about 75 percent hardwood, check plot 2 about 65 percent hardwood, and check plot 3 with little or no hardwood in the canopy. All three of the released plots should end up with 100 percent pine in the canopy.

Cordwood yields of loblolly were related to the amount of hardwood present. Figure 2 shows pine cordwood yields related to total hardwood basal area at age 18, for the six plots. A simple linear regression fitted to these data accounted for 78 percent of the variation in cordwood yields.³ Cordwood yields were even more strongly related to just the amount of hardwood basal area in intermediate, codominant, and dominant crown classes (Figure 3). A simple linear regression fitted to these data accounted for 88 percent of the variation in cordwood yields.⁴

Cordwood yields also correlated very well with the average free-to-grow index for each plot at age 2. Table 7 shows the percent of trees in each free-to-grow class for each plot, at age 2. In Figure 4, pine cordwood yields at age 18 are plotted over the average free-to-grow index at age 2 for each plot. A simple linear regression fitted to these data accounted for 87 percent of the variation in cordwood yields.⁵

²Standard cords at age 18 were subjected to an analysis of variance for randomized blocks (caution should be used in interpreting the results of this analysis because treatments could not be truly randomized). Yields on released plots were not significantly greater than on check plots (probability of a larger F = .065).

³Estimated standard cords = 30.17 - .3463 (total hardwood basal area), $r^2 = .784$, probability of a larger F = .019.

⁴Estimated standard cords = 22.16 - .4385 (hardwood basal area in I, CD, and D trees), $r^2 = .877$, probability of a larger F = .006.

⁵Estimated standard cords = 47.13 - 15.8936 (free-to-grow index at age 2), $r^2 = .868$, probability of a larger F = .007.

Table 1. A summary of loblolly data at ages 2, 6, 10, 14 and 18: number of trees per acre, average DBH, basal area per acre, standard cords per acre, and average height of dominant and codominant trees.*

Age	Check Plots						Released Plots					
	Plot	No.	DBH	B.A.	Cds.	Ht.	Plot	No.	DBH	B.A.	Cds.	Ht.
2	1	460	-	-	-	2.0	1	480	-	-	-	2.3
	2	420	-	-	-	1.9	2	580	-	-	-	2.1
	3	620	-	-	-	2.1	3	560	-	-	-	2.0
	Means	500	-	-	-	2.0	Means	540	-	-	-	2.1
6	1	350	.93	2.3	-	14.0	1	430	1.94	10.1	-	16.4
	2	420	.92	2.4	-	-	2	580	2.03	14.4	-	15.8
	3	600	1.16	5.9	-	14.8	3	560	1.48	8.0	-	13.5
	Means	457	1.00	3.5	-	14.4	Means	523	1.82	10.8	-	15.2
10	1	230	2.40	8.9	.1	23.5	1	410	3.88	36.7	1.6	27.2
	2	300	2.21	9.6	0	23.7	2	580	4.10	57.1	2.8	28.2
	3	480	2.80	25.5	.7	26.8	3	520	3.88	45.5	1.6	25.4
	Means	337	2.47	14.7	.3	24.7	Means	503	3.95	46.4	2.0	26.9
14	1	190	3.79	17.6	1.2	31.3	1	410	5.17	65.3	7.5	35.4
	2	220	3.86	20.2	1.3	31.2	2	570	5.35	94.4	11.7	36.2
	3	380	4.58	48.2	5.0	35.1	3	520	5.25	83.3	9.2	34.7
	Means	263	4.08	28.7	2.5	32.5	Means	500	5.26	81.0	9.5	35.4
18	1	160	4.81	23.6	3.3	42.0	1	400	6.00	84.0	13.9	43.2
	2	200	4.75	27.1	3.4	42.5	2	550	6.25	122.9	22.7	45.8
	3	360	5.61	66.8	11.1	45.1	3	490	6.22	109.5	19.2	44.7
	Means	240	5.06	39.2	5.9	43.2	Means	480	6.16	105.5	18.6	44.6

*Except at age 2, where heights presented are for all trees.

Table 2. Average differences between check and released plots at each measurement, for basal area and standard cords per acre.

Released minus Check		
<u>Age</u>	<u>Basal Area</u>	<u>Std. Cds.</u>
6	7.3	-
10	31.7	1.7
14	52.3	7.0
18	66.3	12.7

Table 3. Average number of loblolly pine per acre by diameter class at age 18.

<u>DBH</u>	<u>Check Plots</u>	<u>Released Plots</u>
2	17	7
3	27	23
4	40	27
5	47	77
6	56	143
7	33	113
8	13	73
9	7	17
Totals	240	480

Table 4. Average numbers of hardwoods per acre by species and diameter class at age 18.

<u>Species</u>	Check Plots							<u>Totals</u>
	DBH							
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	
Chestnut oak	27	17	20	47	40	13		164
White oak	40	43	3	3			3	92
Red oak	63	63	50	60	17			253
Red maple	300	124	57	44	10			535
Hickory	526	210	86	10				832
Dogwood	460	57						517
Black cherry	220	40	27	13	7	7		314
Blackgum	223	13						236
Yellow-poplar	60	10	10	3	10			93
Persimmon	57	33	10					100
Sourwood	43	27	7					77
Hornbeam	17							17
Hawthorn	7							7
Totals	2,043	637	270	180	84	20	3	3,237

<u>Species</u>	Released Plots						<u>Totals</u>
	DBH						
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	
Chestnut oak	53	17	17	20	3		110
White oak	130	50	13		4	3	200
Red oak	294	143	34	13	10		494
Red maple	233	53	33	7			326
Hickory	590	80	3				673
Dogwood	424	30					454
Black cherry	203	47	17	3			270
Blackgum	43						43
Yellow-poplar	70						70
Persimmon	27						27
Sassafras	33						33
Hawthorn	33						33
Totals	2,133	420	117	43	17	3	2,733

Table 5. Average numbers of hardwoods per acre by diameter class and crown class, and basal area by crown class, at age 18.

Check Plots					
<u>DBH</u>	<u>Over-topped</u>	<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	<u>Totals</u>
1	2,043				2,043
2	637				637
3	120	150			270
4	27	87	63	3	180
5		7	53	24	84
6				20	20
7				3	3
Totals	2,827	244	116	50	3,237
B.A.	33.3	15.9	12.7	8.3	70.2
Released Plots					
<u>DBH</u>	<u>Over-topped</u>	<u>Intermediate</u>	<u>Codominant</u>	<u>Dominant</u>	<u>Totals</u>
1	2,133				2,133
2	420				420
3	87	30			117
4		30	13		43
5		7	10		17
6		3			3
Totals	2,640	70	23		2,733
B.A.	25.1	5.6	2.5		33.2

Table 6. Numbers of hardwoods by diameter class and crown class, and basal area by crown class, on each 1/10-acre plot.

	DBH	Q	I	CD	D	Totals
Check 1	1	177				177
	2	54				54
	3	12	14			26
	4	5	15	11	1	32
	5		1	2	2	5
	6					2
	7					1
Totals		248	30	13	6	297
B.A.		3.17	2.13	1.23	1.02	7.55
Check 2	1	141				141
	2	56				56
	3	10	17			27
	4	2	5	5		12
	5		1	9	4	14
	6					3
Totals		209	23	14	7	253
B.A.		2.66	1.41	1.66	1.13	6.86
Check 3	1	295				295
	2	81				81
	3	14	14			28
	4	1	6	3		10
	5			5	1	6
	6					1
Totals		391	20	8	2	421
B.A.		4.15	1.21	.94	.33	6.64

	DBH	Q	I	CD	D	Totals
Released 1	1	204				204
	2	45				45
	3	6	3			9
	4		3	2		5
	5		2			2
Totals		255	8	2		265
B.A.		2.39	.68	.18		3.25
Released 2	1	173				173
	2	43				43
	3	13	5			18
	4		3	1		4
	5			2		2
Totals		229	8	3		240
B.A.		2.52	.51	.36		3.39
Released 3	1	263				263
	2	38				38
	3	7	1			8
	4		3	1		4
	5			1		1
	6		1			1
Totals		308	5	2		315
B.A.		2.61	.51	.22		3.34

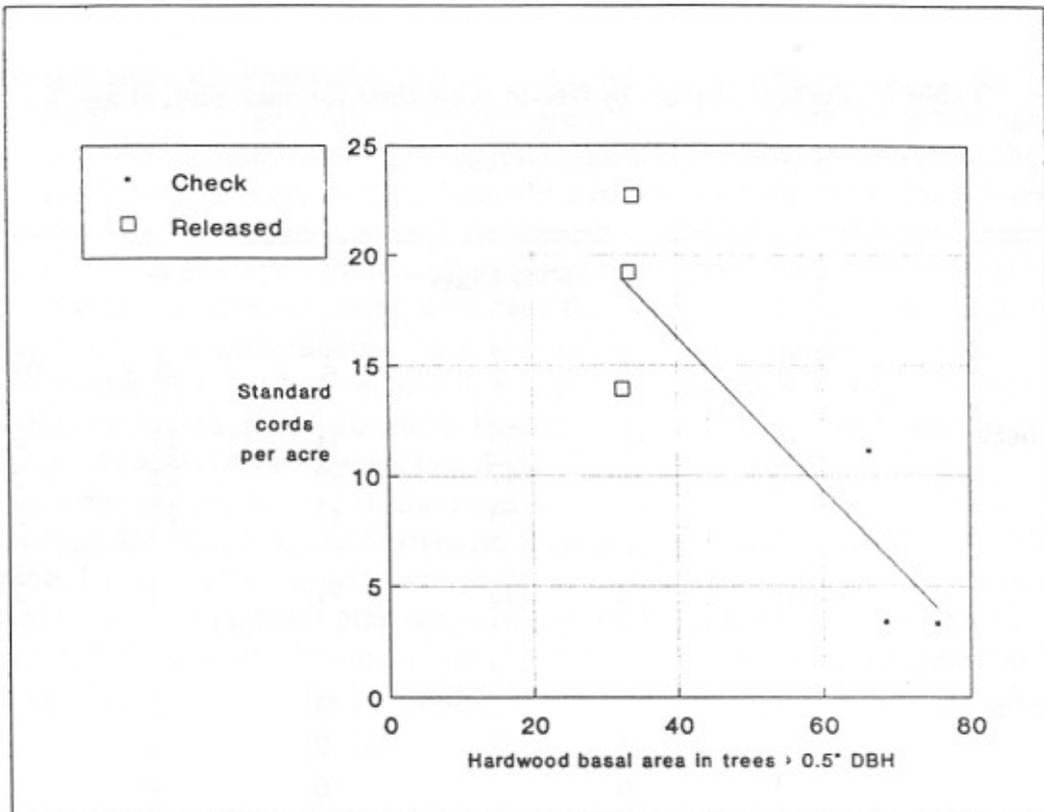


Figure 2. Pine cordwood yields at age 18 related to hardwood basal area.

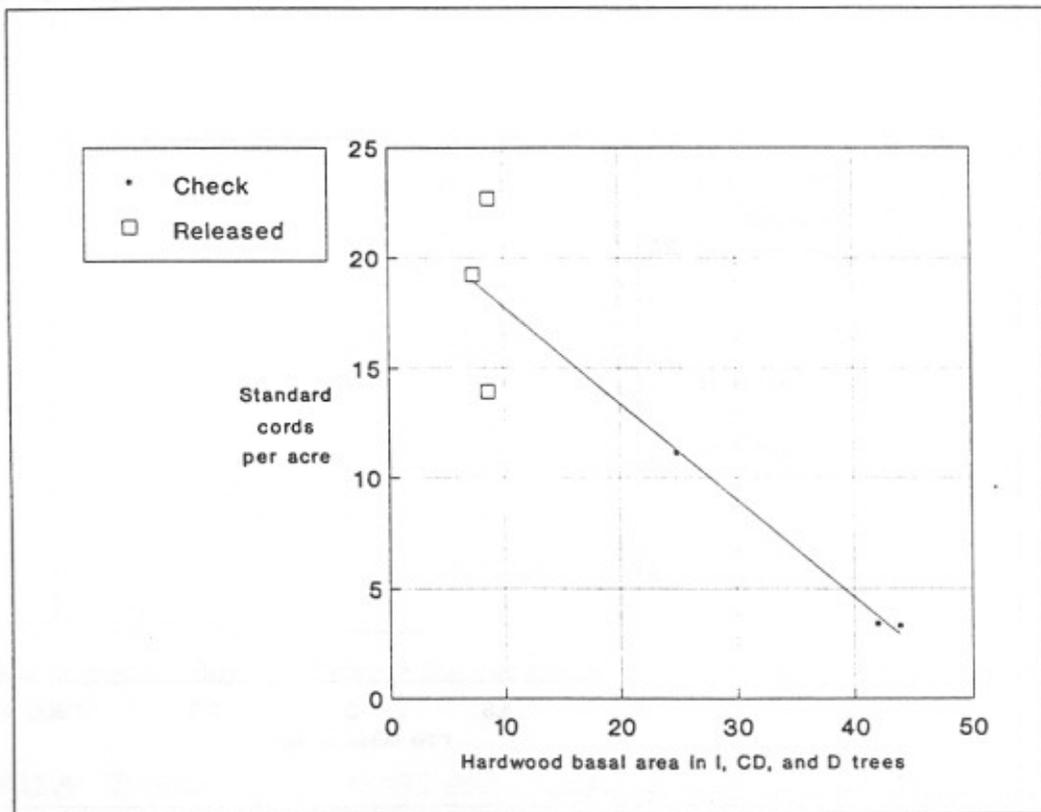


Figure 3. Pine cordwood yields at age 18 related to hardwood basal area in intermediate, codominant, and dominant trees.

Table 7. Percent of trees by free-to-grow class for each plot, at age 2.

		FTG Class				
		1	2	3	4	Means
	Plot					
Check	1	2	36	51	11	2.71
	2	3	47	39	11	2.58
	3	2	53	33	12	2.55
	Means	2	45	41	11	2.61
Released	1	24	65	9	2	1.89
	2	36	62	2	0	1.66
	3	36	55	6	4	1.77
	Means	32	61	6	2	1.77

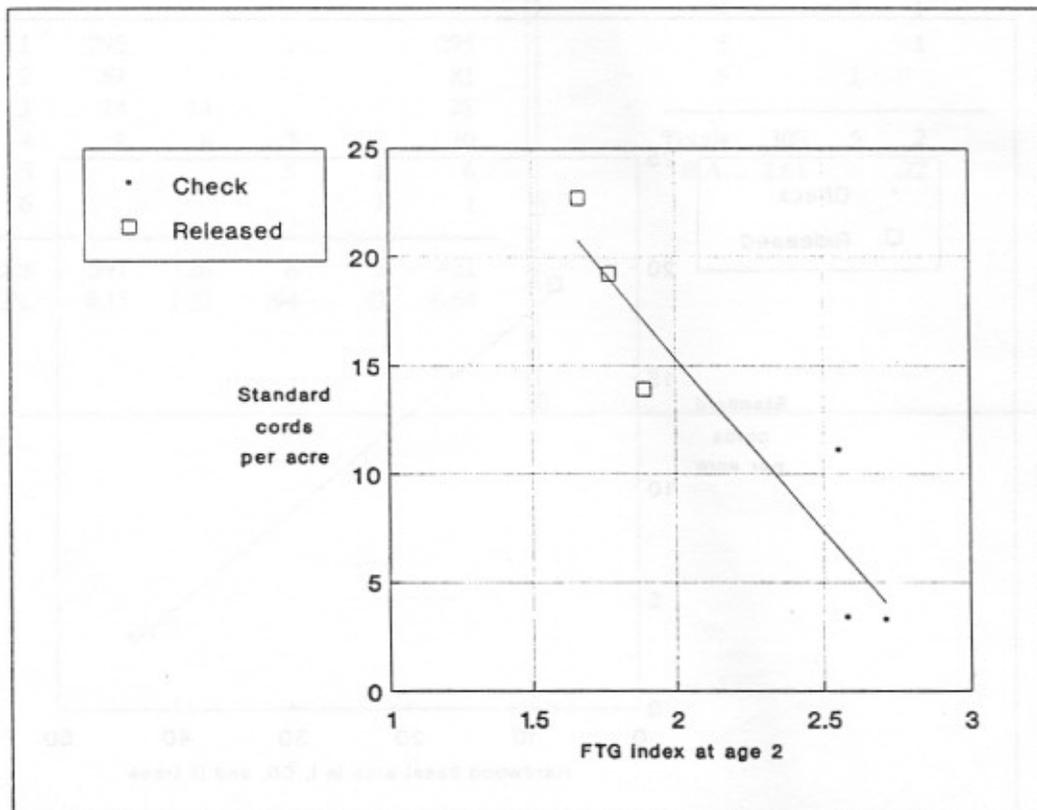


Figure 4. Pine cordwood yields at age 18 related to FTG index.

Dominant and codominant loblolly pine have grown faster on the released plots than on the check plots (Table 1). Average height differences were .1, .8, 2.2, 2.9, and 1.4 feet at ages 2, 6, 10, 14, and 18, respectively. There is nothing to suggest that site index should be higher on the released plots, as topography and soils are similar. Hardwood competition seems to have affected height of dominant and codominant pines, as we have noticed in other release studies.⁶ This study, in particular, provides an example of how such differences can arise as a result of early hardwood competition. At the age 6 measurement, we judged that there were no pines on check plot 2 that qualified as dominant or codominant (Table 1). At later measurements, however, there were several pines on this plot that had become dominant or codominant, finally growing above the hardwoods that earlier had caused them to be intermediates. Someone measuring this plot for the first time at age 18 could not have known that these trees had moved up to a codominant position. At age 18, we measured 14, 18, and 16 dominant and codominant loblolly on released plots 1, 2, and 3 respectively, but only 3, 4, and 13 trees on check plots 1, 2, and 3. The three and four trees on check plots 1 and 2 were all that were present in these crown classes. Average height of dominant and codominant loblolly pine at age 18 is plotted over hardwood basal area at age 18 in intermediate, codominant, and dominant trees, for all six plots (Figure 5). The relationship is not statistically significant⁷, but note the position of plot pairs 1 and 2 on the graph.

⁶See Occasional Report No. 75 (Release Report No. 8) for a discussion of this relationship and its probable cause.

⁷Estimated D & CD pine height = $45.33 - .0643$ (hardwood basal area in I, CD, and D trees), $r^2 = .513$, probability of a larger F = .116.

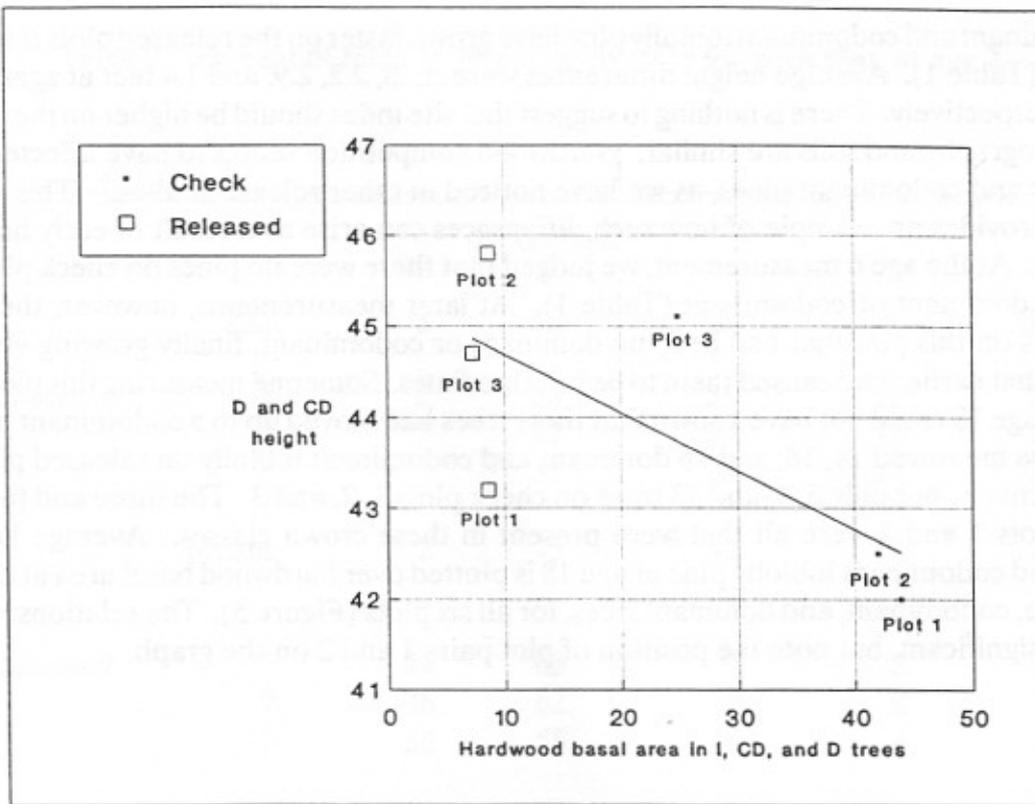


Figure 5. Pine dominant and codominant height at age 18 related to hardwood basal area in intermediate, codominant, and dominant trees.